Lunar Reconnaissance Orbiter (LRO) Project

Component Mechanical Interface Control Drawing Guidelines Handbook

Prepared by: Gordon Casto/543 and Giulio Rosanova/543

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Goddard Space Flight Center
Greenbelt, Maryland

National Aeronautics and Space Administration

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1.0 INTRODUCTION

1.1 Purpose

The purpose of this document is to provide guidelines for the preparation of Mechanical Interface Control Drawings (MICDs) for the LRO Orbiter components, both Instruments and spacecraft (SC) subsystems. In order to meet the component accommodation requirements imposed on the Mechanical sub-system team, mechanical interface definition details are required from each of the LRO instruments and sub-system groups. This level 2 requirement is captured in the Lunar Reconnaissance Orbiter Project Mission Requirements Document (431-RQMT-00004), and subsequently imposed in the Lunar Reconnaissance Orbiter Mechanical System Specification (431-SPEC-000012).

Mechanical interface information is best transmitted and controlled by an MICD. This method provides enough detail about a subsystem component in order that the LRO mechanical team can design the SC structure to accommodate all instrument and sub-system component needs. Specific details of these requirements are listed in this document.

1.2 SC SUB-SYSTEM COMPONENT TABLE

The LRO SC components are listed in following table:

Propulsion Module (PM) Component ICD's
Fuel Tank(s)
Pressurent Tank
Thrusters (#?)
Fuel Pressure Module (FPM)
Fuel Control Module (FCM)
Plumbing Lines
Fill & Drain Adapters
Coarse Sun Sensors
PM Thermal Components
PM Wiring Harness (Including Thermal Heater Blocks, & 1553 Couplers)
OMNI Antenna (1)
Reaction Wheel Assy. (4)

Avionics Module (AM) Component ICD's
C&DH
PDE
PSE
Battery
OMNI Antenna (1)
Gimbal Control Electronics Box

Thermal Components
Wiring Harness (Including Thermal Heater Blocks, & 1553 Couplers)
Coarse Sun Sensors
Ka Transmitters
Ka Transfer Switch
Ka Waveguide
S-Band Hybrid
S-Band Transponder/Di-plexor
S-Band Directional Coupler

Instrument Module (IM) Component ICD's
LOLA
LROC
LEND
LAMP
CRaTER
DLRE (Diviner)
Star Trackers (2)
IM Thermal Components
IM Wiring Harness (Including Thermal Heater Blocks, & 1553 Couplers)
Coarse Sun Sensors
GYRO/IRU (1

High Gain Antenna Deployment & Articulation System (HGADAS)
High Gain Antenna

Solar Array Deployment & Articulation System (SADAS)
Solar Array (Cells)
Coarse Sun Sensors
DPLY Wiring Harness

2.0 CAD Models

If the Computer-Aided Design (CAD) Model of the component is available, it should be provided to the mechanical group. The model will be incorporated into the over-all LRO Orbiter model. Native file format of the CAD package may be used (PRO-E, IDEAS, or SOLID WORKS), standard translation format (STEP, or IGES) may also be used. This model should be reduced to external surfaces, blanket volumes, science field of view (FOV), science field of regard (FOR), and thermal FOV.

3.0 Mechanical Interface Control Drawing Guidelines

A Mechanical Interface Control Drawing (MICD) shall be developed for each LRO component needing support from the LRO Mechanical Systems group. Multiple components provided as a sub-assembly may be incorporated onto a single MICD.

The MICDs shall contain the information listed below, as applicable:

- Preferred component orientation as required
    - LRO coordinate definition: +X axis is along the Orbiter Thrust direction, +Z axis is Lunar Nadir pointing, and +Y completes the right-hand-rule.

- Component Identification as required
    - Indicate nomenclature, part number, and location of identification feature.

- Component Dimension (Dimensions shall be provided in the native units with tolerances, either metric or English, and the non-native units noted parenthetically)
    - Overall Package dimensions, physical envelope
    - Indicate footprint size, shape, and dimensions, including any critical tolerances.
    - Indicate minimum material wall thicknesses, for radiation ray trace studies
    - Indicate Thickness of Mounting Flanges
    - Indicate contact area to mechanical structure.
    - Indicate if there are any external moving parts (doors, etc.) and the deployment volume.

- Thermal H/W information
    - Envelope dimensions for add-ons such as thermal blankets and thermal control hardware.
    - Indicate thermal gasket material (i.e. co-therm or indium) requirements
    - Indicate surface Finish/Coatings External surfaces only.
    - Indicate footprint size or mating area to be masked, if applicable.

- Materials specification relevant to mechanical interface (i.e. Aluminum 6061-T6)

- Mounting Surface:

    - Flatness requirement
    - Co-planarity requirement
    - Surface finish requirements of mounting location: Example; mounting locations under the bolt heads shall be masked or spot faced to remove any paint or anodize coatings and shall conform to MIL-C-5541, class3. Spot face shall have a minimum diameter of .500” to accommodate the washer or shim under the bolt.

- Mounting Holes

  - Location, size, and tolerance
  - Indicate if drill templates or fit check templates are required/desired

- Mounting fasteners
  - Size, thread-form, length and quantity used. Length is typically 2 X Diameter thread engagement plus thickness of mounting flange and thermal gasket layer, i.e., co-therm/indium).
  - Fasteners are typically supplied by the GSFC Mechanical Group. LRO has baselined standard English fasteners, #6's, #8's, #10's, or .250" made from 160 ksi A-286 material. The specifications for the socket head cap screws is NAS1351.
  - The spacecraft mounting fastener mass will be included as part of the subsystem component (avionics package), not the Spacecraft structure.
  - Special spacecraft mounting fasteners, such as those not in the GSFC Flight Fasteners inventory, shall be supplied by the component provider and their part #, and vendor information indicated in a note on the MICD.
  - Indicate installation torque, if different than LRO torque table (431-REF-**TBD**).
  - If thermal standoffs are required, indicate type, material, size, location, etc.

- GSE Handling Points
  - Handling points will be required for boxes and assemblies weighing 50 pounds (22.7kg) or more.
  - Location, size, and tolerance of pick-up points.
  - Any restrictions or precautions on handling.
  - LRO component placement may require the use of a "Pickle Fork" for installation. This will require the component to provide (4) **TBD** threaded inserts to each corner of the component, on the opposite side of the mounting surface.

- Access zones to support integration and testing (i.e., sources required for calibration, etc. can be indicated here also.)
  - This identifies proximity to other components and or structure assembly.
  - When is access required? (List all times when needed, T-24hours, or during safe to mates at integration?)

- Mass shall be presented in pounds to 2 decimal places & (parenthetically in kilograms)

- Center of Gravity location. +/- 0.5 in. (13mm) accuracy.

- Connectors
  - Interface and test connectors, location, type, keying, Identification #, protrusion dimensions and connector cut-out specifications. (this information will be used to develop the wiring harness mock-up, which includes hi-fidelity component connector representation)

  - Connector back shell and harness loop access envelope and stay out zones (this identifies proximity to other components and or structure for the assembly).
  - This information must be obtained from LRO Electrical System group

- Electrical Grounding provisions
  - Indicate grounding strap mounting holes, size, location, tolerance
  - Exact component grounding interface information must be obtained from LRO Electrical System group

- Optical Reference Surfaces (as required)
  - Alignment cube/reference mirror surfaces: size, and location, if applicable
  - This will be negotiated between components and the mechanical groups in order that the line of sight may be maintained at the assembly level.

- Alignment
  - Placement accuracy. How well does the component need to be placed (aligned) W.R.T. the master reference cube? How well does the component need to be measured W.R.T. the master reference cube?
  - List mechanical stability requirements from alignment to on orbit operations.

- Fields of View (FOV)
  - Include optical, RF and Thermal Radiator fields of view, as applicable

- Identify Vent Path for components

- Purge port locations, purge gas and flow requirements. List maximum time off purge. List any purge requirements prior to powered operations.

3.1 Mechanical Interface Control Drawing Responsibilities

Each component Product Development Lead (PDL) will develop and maintain the MICD. The MICD will be given its own unique LRO CM drawing number and placed under LRO CM control in accordance with the Lunar Reconnaissance Orbiter Project Configuration Management Procedure (431-PROC-000179). Once prepared, all parties involved in the interface will review and approve the drawing. At a minimum, the component lead and mechanical systems lead (or their designees) will sign the MICDs.

System level implementation of the component will then be described on a Mechanical Implementation Assembly Drawing (MIAD). The MIAD is similar to the mechanical sub-assembly drawings, but has more specific information about the component. The MIAD will be developed by the LRO mechanical group, and will also follow LRO CM procedures in order that it can be approved and configured in accordance with the Lunar Reconnaissance Orbiter Project Configuration Management Procedure (431-PROC-000179).

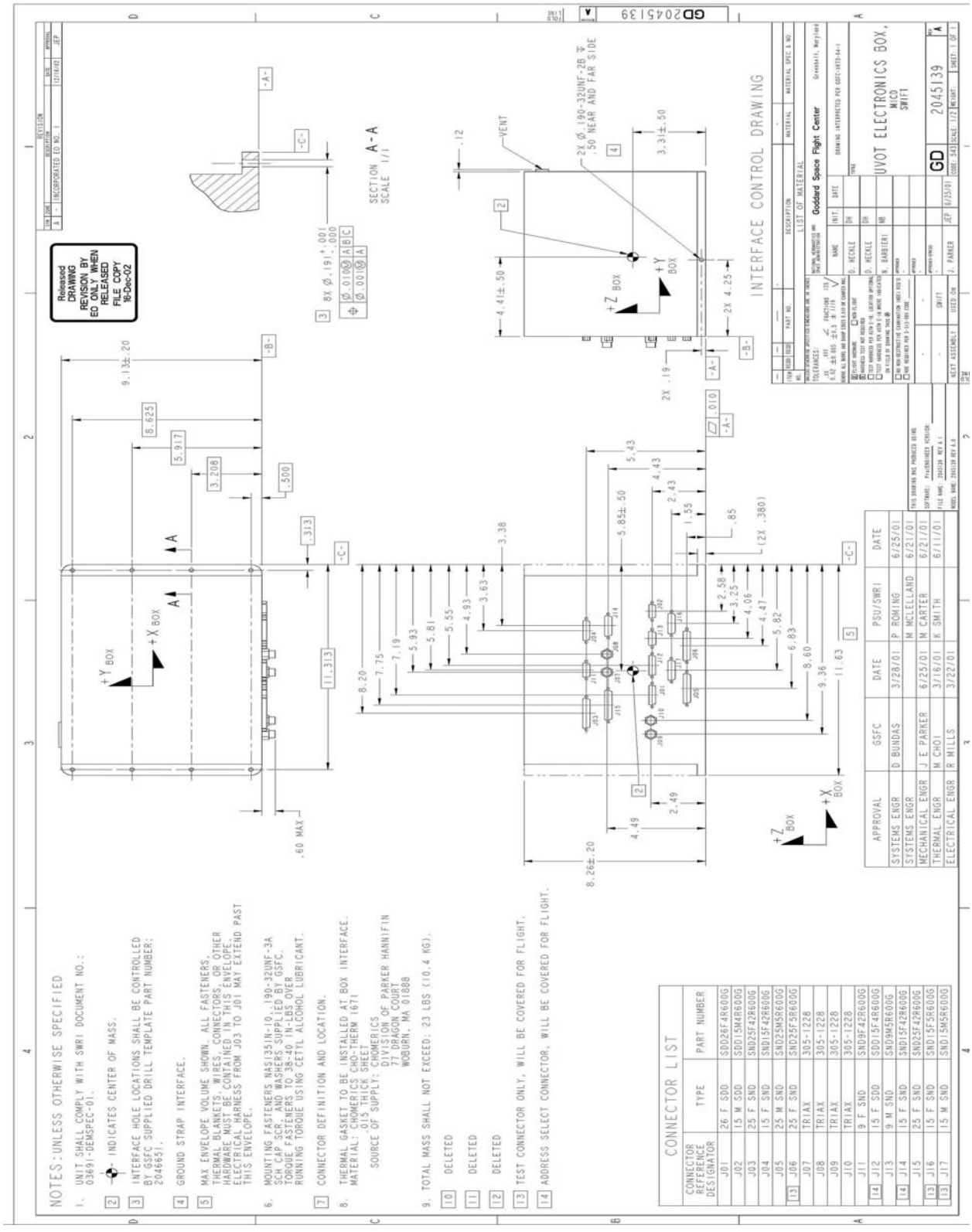
For vendor supplied components, the PDL is responsible for developing a LRO ICD which includes the vendor's ICD and any additional LRO MICD required information.

4.0 Mechanical Interface Control Drawing Example

The following example was taken from the SWIFT program and provides the typical level of detail required for a small electronics box to be interfaced to a spacecraft.

Note that for complex subsystems, the drawing may require two or more pages to fit all the information.

Example of Typical MICD shown next page



APPENDIX A. ACRONYM AND ABBREVIATION

Abbreviation/ Acronym	Definition
FOV	Field of View
FOR	Field of Regard
ICD	Interface Control Document
LRO	Lunar Reconnaissance Orbiter
MICD	Mechanical Interface Control Drawing
MRD	Mission Requirements Document